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EXHIBIT A (FIRST PAGE OF FOUR PAGES)

1,1'-ferrocenedicarboxylic acid dimethyl ester. See dimethyl ferrocenoate.

1,1'-ferrocenediyl dichlorosilane. $(C_5H_4)_2FeSiCl_2$. An experimental ferrocene derivative that prevents oxidative deterioration of the surfaces of photoelectrodes with which it is in contact. It increases the stability of light-sensitive electrodes in energy-conversion reactions occurring in liquid media.

ferrocenoyl chloride. See chlorocarbonyl ferrocene.

ferrocenoyl dichlor [illegible] 1,1'-dichlorocarbonyl f

ferrocenylboran

Properties: Long-.. [illegible] resistance [illegible] 5C, short-term stability appr[illegible]mately 815C. g[illegible] resistance to oxidation and hydrolysis. contains up to 30% iron directly combined.

Use: Specialty plastics, coatings, fibers; ablative material for space vehicles.

NOTE

ferrocenyl methyl ketone. See acetylferrocene.

ferrocerium. A pyrophoric alloy of iron and misch metal.

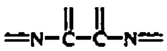
ferrochromium. (ferrochrome). An alloy, composed principally of iron and chromium, used as a means of adding chromium to steels (low, medium, and high-carbon) and cast iron. Available in several classifications and grades, generally containing between 60 and 70% chromium, in crushed sizes and lumps up to 75 pounds that readily dissolve in molten steel.

ferroconcrete. See concrete.

ferroelectric. A crystalline material such as barium titanate, monobasic potassium phosphate, or potassium-sodium tartrate (Rochelle salts) that, over certain limited temperature ranges, has a natural or inherent deformation (polarization) of the electrical fields or electrons associated with the atoms and groups in the crystal lattice. This results in the development of positive and negative poles and a consequent "direction" of polarization, which can be reversed when the crystal is exposed to an external electric field. Ferroelectric crystals are internally strained and, as a consequence, show unusual piezoelectric and elastic properties.

Use: Capacitors, transducers, computer technology. See ceramic, ferroelectric.

ferroin chelation group. A functional group characteristic of heterocyclic ring nitrogen compounds:



$$=N-\overset{\|}{C}-\overset{\|}{C}-N=$$

Among such compounds are 2,2'-bipyridine; 1,10-phenanthroline; and the 2-pyridyl triazines. These provide a large number of terminal (≡C–H) groups in which the hydrogen can be replaced by many chemical groupings (carboxyl, hydroxyl, halogen, etc.). Thus, synthesis of an almost endless number of substituted ferroin reactants is possible. About 200 such chelation reagents have been synthesized. Ferroin chelation chemicals in general form complex undissociated cations with divalent metal ions, e.g., $[(C_{12}H_8N_2)_3Fe]^{2+}$.

ferromagnesite. An iron-bearing variety of magnesite.

Use: Refractory owing to its ability to bond under heat.

ferromagnetic oxide. See ferrite (2).

NOTE

ferromanganese. An alloy consisting of manganese (approximately 48%) plus iron and carbon.

Available forms: Standard, low-carbon, and medium-carbon grades in ground, crushed, and lump sizes ranging from 80 mesh to 75-lb lumps, suitable for ladle or furnace addition.

Use: Vehicle for adding manganese to steel. See nodules.

ferromolybdenum. An alloy, composed largely of iron and molybdenum, used as a means of adding molybdenum to steel. Engineering steels rarely contain more than 1% molybdenum, stainless steels may contain 3%, and tool steels as much as 10%. Ferromolybdenum is available in several grades in which molybdenum ranges from 55 to 75% and the maximum carbon content is 1.10%, 0.60%, or 2.50%. It is generally added in the furnace since it does not oxidize under steelmaking conditions. Mp approximately 1630C. Available in crushed sizes up to one inch.

ferroniobium. An alloy of iron and niobium made by reducing the ore columbite with silicon.

Use: Stainless steels and other alloys for welding rods.

ferrophosphorus. An alloy of iron and phosphorus used in the steel industry for adjustments of phosphorus content of special steels.

Grade: (1) 18% phosphorus, (2) 25% phosphorus.

Use: In preventing thin sheets from sticking together when rolled and annealed in bundles.

ferrosilicon. An alloy of iron and silicon used to add silicon to steel and iron, d 5.4, insoluble in water. Small quantities of silicon deoxidize the iron, and larger amounts impart special properties.

Available forms: Six grades containing from 20 to 95% silicon. The 20% grade is made in a blast

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EXHIBIT A (SECOND PAGE OF FOUR PAGES)

tant, textiles (dyeing and calico printing), flocculant in water and sewage purification, soil conditioner, polymerization catalyst, metal pickling, chelated iron products, intermediate.

ferric tallate. See soap (2).

ferric tannate. (iron tannate; iron gallotannate). $Fe_2(C_{14}H_7O_9)(OH)_3$.
Properties: Dark-brown or bluish-black powder. Variable composition. Soluble in alkalies and dilute acids; insoluble in water, alcohol, and ether. Combustible.
Derivation: Interaction of ferric acetate and tannic acid solutions.
Use: Medicine.

ferric tribromide. See ferric bromide.

ferric trichloride. See ferric chloride.

ferric trioxide. See ferric oxide.

ferric trisulfate. See ferric sulfate.

ferric vanadate. (iron metavanadate). $Fe(VO_3)_3$.
Properties: Grayish-brown powder. Soluble in acids; insoluble in water and alcohol. Noncombustible.
Derivation: By adding a solution of a ferric salt to the liquor obtained by leaching vanadium ores with caustic-soda solution or by lixivating the slags obtained when vanadium ores are fused with soda ash, etc.
Grade: Technical.
Use: Metallurgy.

NOTE

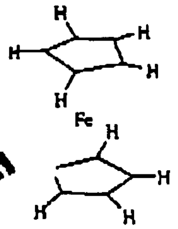
ferrite. (1) Iron in the body-centered cubic form; commonly occurs in steels, cast iron, and pig iron at approximately 910C. α and β iron are the common varieties of ferrite, and the name is also applied to Δ iron. (2) A compound, a multiple oxide, of ferric oxide with another oxide, as sodium ferrite, $NaFeO_2$, but more commonly a multiple oxide crystal. Ferrites are made by dissolving hydrated ferric oxide in concentrated alkali solution; by fusing ferric oxide with alkali metal chloride, carbonate, or hydroxide; or by simply heating metal oxides with ferric oxide. Ceramic ferrites are made by press-forming powdered ingredients (with a binder) into a sheet, then sintering or firing.
Use: The oxide ferrites in rectifiers on memory and record tapes, for permanent magnets, semiconductors, insulating materials, dielectrics, high-frequency components, and various related uses in radio, television, radar, computers, and automatic control systems.

ferro-alloy. An alloy of iron with some element other than carbon used as a vehicle for introducing such an element into steel during its manufacture. The element may alloy with the steel by solution or as the carbide, neutralize the harmful impurities by combining with them, and separating from the steel as flux or slag before solidification.

ferroboron. A ferro-alloy used as a hardening agent in special steels. It also is an efficient deoxidizer. Boron steel is used in controlling the operating rate of nuclear reactors. Two grades are available, 10 and 17% boron.

"Ferrocarbo" *(Carborundum).* TM for briquened or granular silicon carbide.
Use: Cupola addition in the production of gray iron or as a ladle addition to steel. Decomposes into its component elements and acts as a powerful deoxidizer and graphitizer. Machinability and strength of the iron or steel are increased with no loss of hardness.

ferrocene. (dicyclopentadienyliron). $(C_5H_5)_2Fe$
A coordination compound of ferrous iron and two molecules of cyclopentadiene in which the organic portions have typically aromatic chemical properties. Its activity is intermediate between phenol and anisole. The first compound shown to have the "sandwich" structure found in certain types of metallocene molecules. Two structures of ferrocene are shown below:



NOTE

Properties: Orange, crystalline solid; camphorlike odor. Mp 173–174C; resists pyrolysis at 400C. Insoluble in water; soluble in benzene, ether, and alcohol. Iron content 29.4–30.6%.
Derivation: From ferrous chloride and cyclopentadiene sodium.
Hazard: Moderate fire risk. Evolves toxic products on decomposition and heating.
Use: Additive to fuel oils to improve efficiency of combustion and eliminate smoke, antiknock agent, catalyst, coating for missiles and satellites, high-temperature lubricant, intermediate for high-temperature polymers, UV absorber.
See metallocene.

ferrocenecarboxylic acid ethyl ester. See ethyl ferrocenoate.

1,1'-ferrocenedicarboxylic acid diethyl ester. See 1,1'-diethyl ferrocenoate.

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EXHIBIT A (THIRD PAGE OF FOUR PAGES)

Hawley's

Condensed Chemical Dictionary

Fourteenth Edition

Revised by
Richard J. Lewis, Sr.

JOHN WILEY & SONS, INC.

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(Seventh Page of Sixteen Pages)

EXHIBIT A (FOURTH PAGE OF FOUR PAGES)

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Published simultaneously in Canada.

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Library of Congress Cataloging-in-Publication Data:

Condensed chemical dictionary.
Hawley's condensed chemical dictionary.—14th ed./ rev. by Richard J. Lewis, Sr. p. cm.
Includes index.
ISBN 0-471-38735-5 (cloth: acid-free paper)
1. Chemistry—Dictionaries. I. Title: Condensed chemical dictionary. II Hawley, Gessner Goodrich, 1905– III. Lewis, Richard J., Sr. IV. Title.

QD5 C5 2002 2001045614
540'.3--dc21

Printed in the United States of America.

10 9 8 7 6 5 4 3 2 1